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THE NORTH AMERICAN SPECIES OF THE GENUS *ZEIRAPHERA*

TREITSCHKE (OLETHREUTIDAE)

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THE NORTH AMERICAN SPECIES OF *ZEIRAPHERA* feed almost entirely on conifers of the tribe Abietae. The only exception is *Z. claypoleana* (Riley) which feeds on *Aesculus* and is morphologically remote from the others. Many of the species occur abundantly enough to be of economic importance and because of this the Forest Insect and Disease Survey, Canada Department of Forestry and Rural Development, has been conducting investigations on them for several years. One result has been the accumulation of about 1400 specimens reared from various conifers in many areas of Canada. The taxonomic study of these forms the basis of this paper.

The specimens were divided in accordance with their respective host trees and geographical areas. A close examination of the maculation and genitalia showed that seven conifer-feeding species are present. Some of these are very closely related but all can be recognized by differences in maculation and in the genitalia. These differences are not always apparent unless examined in series. We have, therefore, usually illustrated the male genitalia of several specimens of each species to show the variation within the species and the differences between them.

A comparison of the North American species with the conifer-feeders of Europe showed that differences exist between them. It has therefore been concluded that the European species *Z. diniana* (Guénee) and *Z. ratzeburgiana* (Ratzeburg) do not occur in North America. *Z. improbana* (Walker) is used for *Z. diniana* of American authors. The North American species formerly considered as *ratzeburgiana* is described below as *canadensis* new species.

GENITALIC DEFINITION OF ZEIRAPHERA TREITSCHKE

Zeiraphera Treitschke, 1829, *Schmett. Europa* 7: 231.

Type species: *Tortrix corticana* Hübner, 1811, *Europa Schmett.* Pl. 3, fig. 13 [= (*Pyralis*) *Zeiraphera isertana* (Fabricius) 1793, *Ent. Syst.* 3: 281; designated by Curtis, 1838, *British Ent.* 15: No. 711.]

Male genitalia. Clasper sickle-shaped; ventral margin spined; apical region tongue-shaped; sacculus not spined; margin between sacculus and apical region not strongly concave. Uncus rudimentary; with specialized scale-like hairs. Socii well developed, long, drooping, broad. Gnathos weakly developed. Aedeagus short, moderately stout; cornuti a cluster of 3-60 elongate spines.

Female genitalia. Eighth, ninth, and tenth abdominal segments very long and slender. Ovipositor retractile. Anterior and posterior apophyses long. Ostial plate arising from near bases of anterior apophyses, elongate, emarginate basally. Ostium somewhat cup-shaped. Ductus bursae constricted; entirely sclerotized, with sclerotized ring only, or membranous. Bursa with one of two scobinate signa.

Key to Species

1. Female bursa with one signum (Fig. 34). Male clasper without subapical constriction (Fig. 32) 2
 Bursa with two signa (Fig. 37). Clasper with subapical constriction (Fig. 26) 6
2. Signum very small (Fig. 35). Ductus bursae membranous. Forewing with an oblique, rectangular, whitish grey patch near middle of dorsum (Figs. 23-24). Hosts: *Picea sitchensis*, *P. engelmanni* 8
 Signum of moderate size (Fig. 40). Ductus bursae weakly sclerotized .. 3
3. Uncus well developed (Fig. 29). Forewing with indistinct maculation and dorsal patch (Figs. 7-11). Hosts: *Larix laricina*, *L. occidentalis* 4. *improbana* (Wlk.)
 Uncus weakly developed (Fig. 30) 4
4. Frons and vertex whitish ochreous. Forewing with a distinct, white, median band not constricted near middle and containing a longitudinal, shining, pale ochreous line (Figs. 12-14). Hosts: *Picea glauca*, *P. engelmanni* 5. *fortunana* (Kft.)
 Frons and vertex greyish brown 5
5. Whitish median band of forewing constricted near middle or separated into a costal and a dorsal patch (Figs. 15-18). Hosts: *Picea glauca*, *P. sitchensis*, *P. engelmanni*, *P. mariana*, *Abies lasiocarpa*, *A. balsamea*, *A. amabilis* 6. *destitutana* (Wlk.)
 Forewing with a distinct, whitish, semi-circular dorsal patch (Figs. 19-22). Hosts: *Pseudotsuga menziesii* 7. *hesperiana* n. sp.
6. One signum broader than the other 7
 Signa almost equal in size 8
7. Neck of bursa with a slender sclerotized ring (Fig. 38). Ostial plate broad. Forewing with a pale brown, triangular, dorsal patch mixed with white scales (Figs. 3-4). Wingspread 12-15 mm. Hosts: *Picea glauca*, *P. sitchensis* 3. *canadensis* n. sp.
 Neck of bursa with a broad sclerotized ring (Fig. 36). Ostial plate slen-

der. Forewing with greenish, blackish, and whitish areas. Male with an indistinct, green dorsal patch; female with a large, blackish dorsal patch (Fig. 2). Wingspread 14-16 mm. Host: *Aesculus glabra* 1. *claypoleana* (Riley)

8. Neck of bursa with a slender sclerotized ring. Forewing with a golden dorsal patch edged with white scales (Figs. 5-6). Wingspread 12-16 mm. Host: *Picea sitchensis* 2. *pacifica* Free.

1. *Zeiraphera claypoleana* (Riley)

Sericorsis instrutana: Claypole, 1881, *Proc. Am. Assn. Adv. Sci.* 30: Riley, 1881, *Am. Nat.* 25: 1009.

Proteoteras claypoleana Riley, 1882, *Amer. Midland Nat.* 10: 913; Forbes, 1923, *Cornell Univ. Agric. Exp. Sta. Mem.* 68: 440.

Steganoptycha claypoleana (Riley), Claypole, 1882, *Psyche* 3: 364; Riley, 1883, *Papilio* 3: 191; Packard, 1890, *Fifth Rept. U.S. Ent. Comm.* 654; Lintner, 1897, *Rept. N. Y. State Ent.* 12: 214.

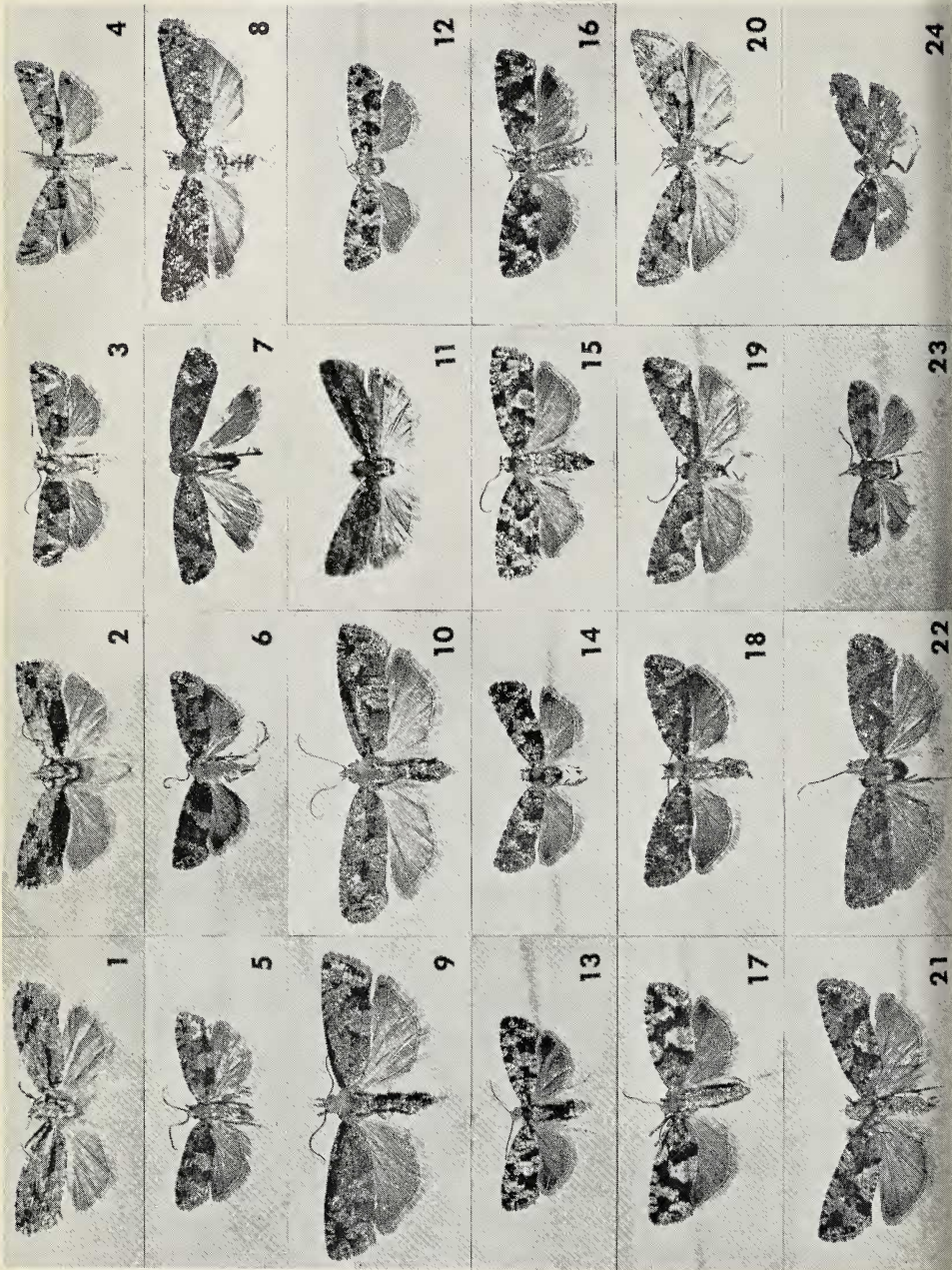
Epinotia claypoleana (Riley), Fernald 1917, in *Dyar List N. Am. Lep.* No. 5232.

Zeiraphera claypoleana (Riley), Heinrich, 1923, *Proc. U. S. Nat. Mus. Bull.* 123: 170.

External characters. Frons fawn colored; roughly scaled. Vertex with long, light fuscous scales mixed with whitish ones. Antenna with light brown and fuscous scales; scape whitish outwardly. Palpus whitish inwardly, brownish fuscous with some whitish scales outwardly. Thorax whitish brown with two lateral, blackish-fuscous spots. Base of tegula blackish. Abdomen pale brown. Legs pale fuscous; fore- and mid-tarsi fuscous with paler bands. Male forewing (Fig. 1) with basal patch whitish on costal half, blackish brown at middle and greenish on dorsum; median band whitish, extending obliquely outward from costa to middle of wing, then acutely angling inward to dorsum, costal portions obscure; apical third whitish, with a brown subapical spot and three brown costal spots; fringe whitish fuscous, with three subapical white dashes. Hind wing pale fuscous; fringe whitish fuscous. Female forewing (Fig. 2) with a large blackish-brown dorsal patch; post-median area and subapical spot greenish. Wingspread 14-16 mm.

Male genitalia (Fig. 25). Uncus pointed at apex. Socii well developed, broadly sickle-shaped. Tegumen obtusely angled. Clasper arcuate, long, slightly expanded at apex, somewhat concave ventrally near base, densely spined. Sacculus weak. Aedeagus short, stout, broader at base; cornuti a cluster of about 20 long spines.

Female genitalia (Fig. 36). Apical region of anterior apophyses expanded. Ostial plate slender, strongly emarginate. Ostium small, cup-shaped. Ductus bursae with a small sclerotized plate. Neck of bursa with a broad sclerotized ring. Signa two, unequal in size, conical.



Flight period. June.

Type locality. Ohio.

Distribution. Ohio, Missouri, Texas.

Host plant. *Aesculus glabra* Willd.

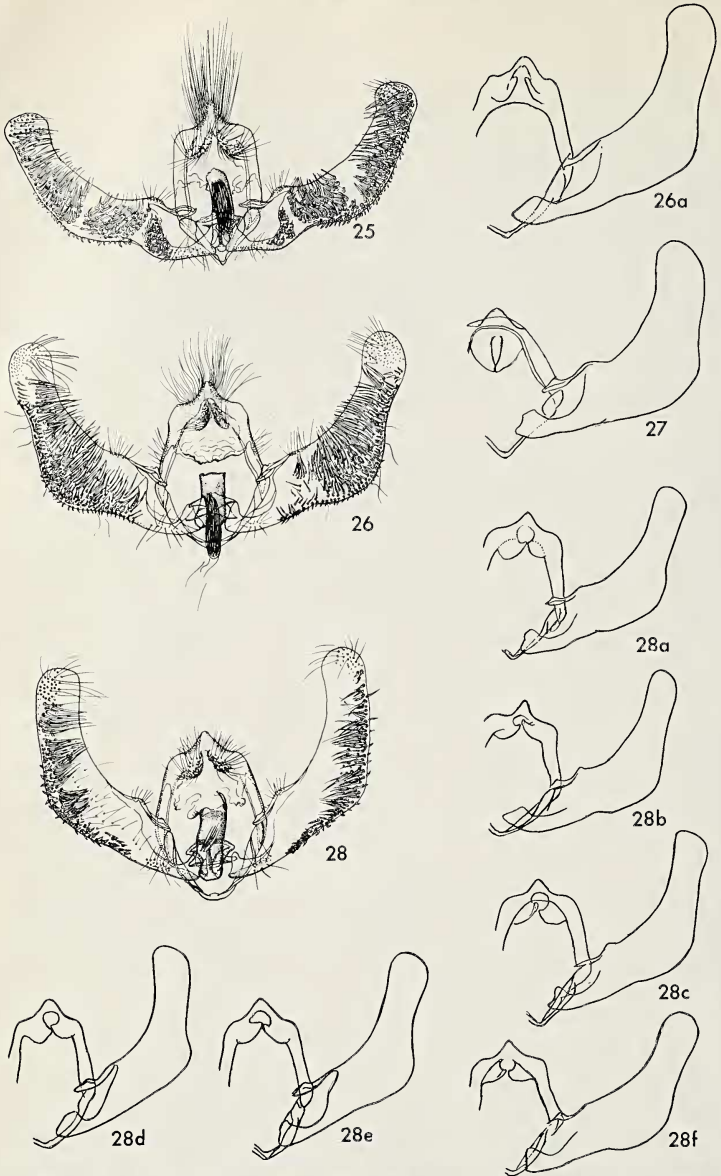
Remarks. This species was placed in this genus provisionally by Heinrich (1923) on the basis of similarities in the male genitalia. However, he indicated that the wing shape, pattern, color and habit were more characteristic of species of *Proteoteras* Riley than of the coniferous feeding species that comprise the genus *Zeiraphera*. Our studies of the female genitalia show a relationship to the coniferous feeding species and support Heinrich's arrangement.

2. *Zeiraphera pacifica* Freeman

Zeiraphera pacifica Free. 1966, Can. Ent. 98: 588.

External characters. Frons with smooth, silver scales. Vertex light golden brown, roughly scaled. Antenna light grey with darker annulations; scape blackish brown inwardly, pale outwardly. Palpus whitish ochreous inwardly, blackish fuscous apically and outwardly. Thorax dark golden brown. Abdomen whitish grey. Fore- and mid-legs purplish black, with greyish bands. Hind leg purplish grey, with whitish bands. Forewing (Figs. 5, 6) with basal patch dark brown, whitish basally, narrowly margined with black apically, extending from just beyond basal fourth of costa obliquely outward to middle of wing, then at right angles inwardly to inner third of dorsum, costal region with

Fig. 1. *Z. claypoleana* ♂, Cincinnati, Ohio; Fig. 2. *Z. claypoleana* ♀, Cincinnati, Ohio; Fig. 3. *Z. canadensis* n. sp. ♀, Ottawa, Ontario; Fig. 4. *Z. canadensis* n. sp. ♀, McGillivray, B.C., *Picea engelmanni*; Fig. 5. *Z. pacifica* ♂, paratype, Sandspit, B.C., *Picea sitchensis*; Fig. 6. *Z. pacifica* ♀, paratype, Sandspit, B.C., *Picea sitchensis*; Fig. 7. *Z. improbana*, paratype of pseudotsugana (Kft.) Kaslo, B.C.; Fig. 8. *Z. improbana* ♀, Pagwal River, Ontario, larch; Fig. 9. *Z. improbana* ♀, Tabor, Ontario, *Larix laricina*; Fig. 10. *Z. improbana* ♀, Wawa, Ontario, *Larix laricina*; Fig. 11. *Z. improbana* ♀, Anarchist Mtn., B.C., *Larix occidentalis*; Fig. 12. *Z. fortunana* ♀ Paratype, Ottawa, Ontario, Fig. 13. *Z. fortunana* ♀, Black Sturgeon Lake, Ontario, *Picea glauca*; Fig. 14. *Z. fortunana* ♀, Yukon Territory, *Picea glauca*; Fig. 15. *Z. destitutana* ♀, Cape Breton, Nova Scotia; Fig. 16. *Z. destitutana* ♀, Black Sturgeon Lake, Ontario, *Picea glauca*; Fig. 17. *Z. destitutana* ♀, Black Sturgeon Lake, Ontario, *Picea glauca*; Fig. 18. *Z. destitutana* ♂, B.C., *Picea glauca*; Fig. 19. *Z. hesperiana* n. sp. ♂, Pavilion, B.C., *Pseudotsuga menziesii*; Fig. 20. *Z. hesperiana* n. sp. ♂, Kelowna, B.C., *Pseudotsuga menziesii*; Fig. 21. *Z. hesperiana* n. sp. ♀, William Head, B.C., *Pseudotsuga menziesii*; Fig. 22. *Z. hesperiana* n. sp. ♀, Yale, B.C., *Pseudotsuga menziesii*; Fig. 23. *Z. vancouverana* ♂, paratype, Ucluelet, Vancouver Island; Fig. 24. *Z. vancouverana* ♀, Vancouver Is., B.C., *Picea sitchensis*.



Male Genitalia: Fig. 25. *Z. claypolana*, Cincinnati, Ohio, Fig. 26. *Z. pacifica*, Sandspit, B.C., *Picea sitchensis*; Fig. 26a. *Z. pacifica*, Sandspit, B.C., *Picea sitchensis*; Fig. 27. *Z. ratzburgiana*, Germany; Fig. 28. *Z. canadensis*, n. sp. Ottawa, Ont.; Fig. 28a. *Z. canadensis*, n. sp. White Pt. Beach, Queens Co. N. S.; Fig. 28b. *Z. canadensis*, n. sp. Ottawa, Ont.; Fig. 28c. *Z. canadensis*, n. sp., Jacquet River, N. B.; Fig. 28d. *Z. canadensis*, n. sp., Zeballos R., B.C., *Picea* sp; Fig. 28e. *Z. canadensis*, n. sp., Zeballos R., B.C., *Picea* sp; Fig. 28f. *Z. canadensis*, n. sp., Prince Edward Island.

three blackish dashes; median band golden brown, the posterior half more distinct, narrowly edged with white and forming a dorsal patch; post median band dark brown; apical third irregularly mottled with golden, white and dark brown areas, the white area often appearing as a gradually broadening streak from tornus half way to costa; apical half of costa with evenly spaced, black dashes; fringe dark grey, with some white tipped scales, and with broken, darker basal line. Hind wing dark fuscous; fringe light grey, with a darker basal line.

Male Genitalia (Fig. 26). Uncus reduced, conical. Socii well developed, broadly sickle shaped. Tegumen broadly shouldered. Clasper well developed, long; heel broadly arcuate; apex broadly rounded. Aedeagus short, stout; apex truncate; cornuti a cluster of about sixteen elongate spines.

Female genitalia (Fig. 37). Apex of anterior and posterior apophyses somewhat broad. Ostial plate broad, not emarginate. Ostium small, somewhat cup shaped. Ductus bursae membranous, with slender sclerotized ring at neck of bursa. Two similar, conical signa present.

Flight period. Late June.

Type locality. Sandspit, Queen Charlotte Islands, British Columbia.

Distribution. Coastal British Columbia and Washington.

Host plant. *Picea sitchensis* (Bong.)

Remarks. This species is closely allied to the European *Z. ratzeburgiana* and to *Z. canadensis*. The head of *pacifica* is golden brown; that of *canadensis* is greyish. The dorsal patches of *canadensis* and *ratzeburgiana* are pale brown and triangular; those of *pacifica* are golden brown and rectangular.

3. *Zeiraphera canadensis* n. sp.

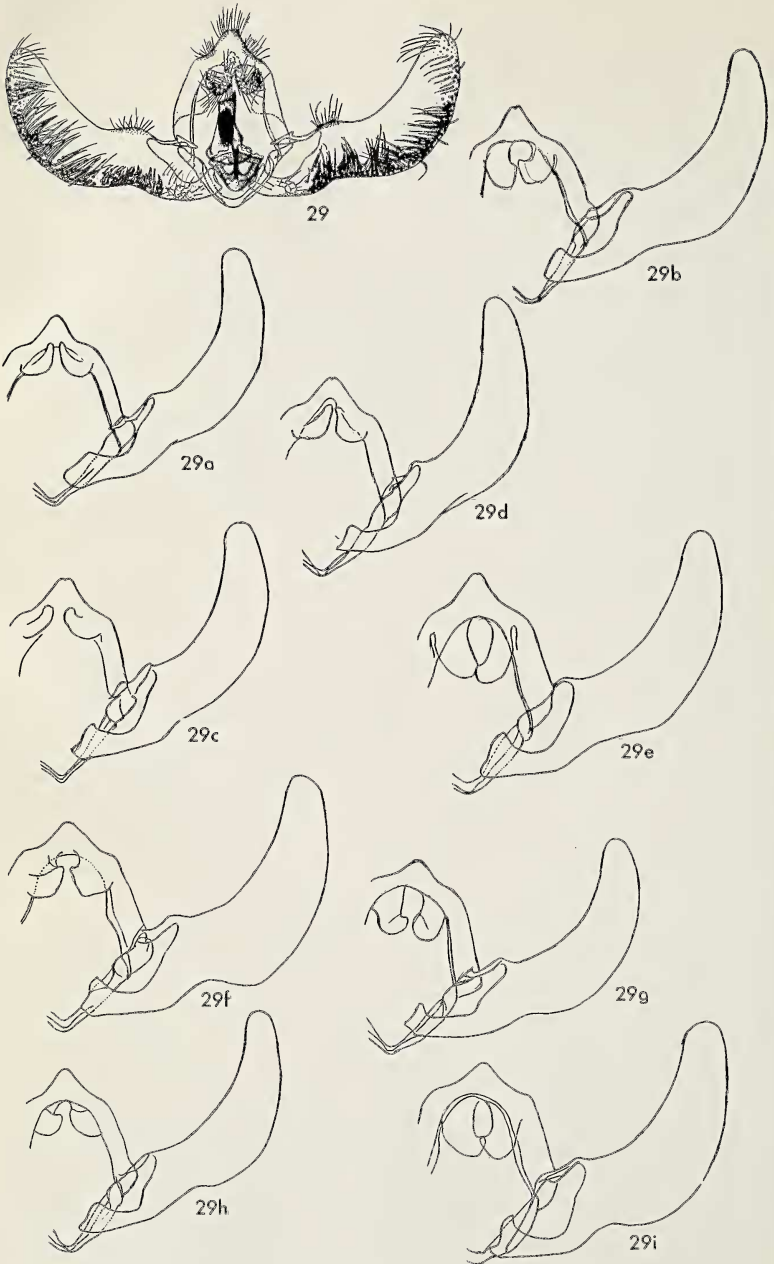
Steganoptycha ratzeburgiana: Fernald, 1884, *Rept. U. S. Dept. Agr.* p. 378; Packard, 1890, *Fifth Report U. S. Ent. Com.*, p. 845.

Epinotia ratzeburgiana: Fernald, 1903, in Dyar, *List N. Amer. Lep.*, No. 5233.

Enarmonia ratzeburgiana: Barnes and McDunnough, 1917, *Check List Lep. Bor. Amer.*, No. 7157.

Zeiraphera ratzeburgiana: Heinrich, 1923, *Bull.* 123, *U. S. Nat. Mus.*, p. 171; Forbes, 1923, *Cornell Univ. Agr. Exp. Sta. Mem.* 68, p. 446; Prentice, et al., 1965, *Dept. Forestry Can., Publ.* 1142, 4: 627.

External characters. Frons smoothly scaled, silvery. Vertex brown, roughly scaled. Antenna light brown, with black scales; scape with blackish scales inwardly, whitish fawn outwardly. Palpus whitish-ochreous inwardly, blackish fuscous anteriorly and outwardly. Thorax blackish brown, with a sprinkling of



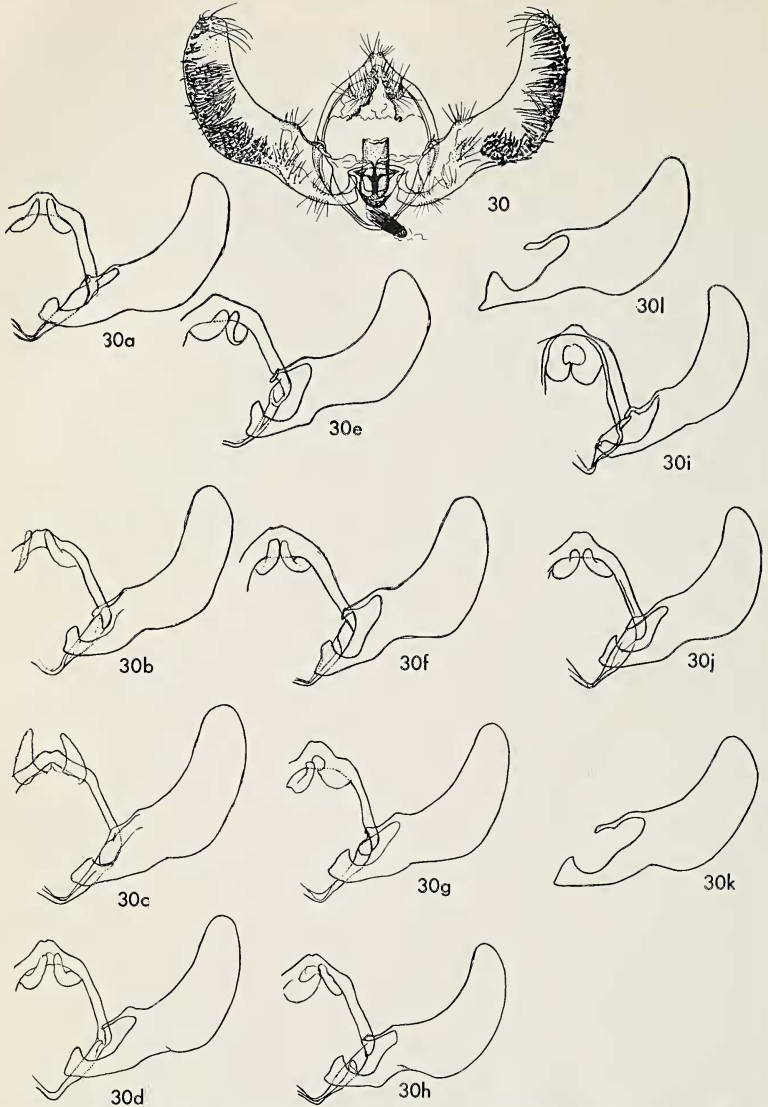
pale ochreous scales. Abdomen pale fuscous; terminal segment with pale brown scales. Fore- and mid-legs blackish fuscous, with pale brown bands. Hind tarsus pale fuscous, with pale brown bands. Forewing (Figs. 3, 4) with basal patch brown, mottled with brownish black, extending from just beyond basal fourth of costa vertically for a short distance, then obliquely angled outwardly to middle of wing, where it angles acutely inward to dorsum beyond basal third; costal area of basal patch with three or four small, blackish costal dashes; median band pale brown, divided into two large patches, one mottled with white scales on costal region, semi-circular, and containing a small costal dash, the other almost triangular with a broken, black, dorsal margin sometimes edged with white scales; post median band brown, becoming whitish on costal area where it contains a small costal dash; apical third irregularly mottled with whitish-grey, fuscous, and brown areas; near outer margin a brown, short, transverse band edged outwardly with white; fringe dark brown, with blackish areas and a broken, darker basal line. Hind wing dark fuscous; fringe light grey, with a darker basal line. Wingspread 12-15 mm.

Male genitalia (Figs. 28-28f). Uncus triangular. Socii broad. Tegumen broadly shouldered. Clasper well developed, long, constricted before apex; heel broadly extended and arcuate; sacculus slender. Aedeagus short, stout; cornuti a cluster of 9-18 spines.

Female genitalia (Figs. 38-38b). Apices of anterior and posterior apophyses somewhat widened. Ostial plate broad, not emarginate. Ostium small, cup-shaped. Ductus bursae membranous, with sclerotized slender ring near neck of bursa. One large and one small conical signum present.

Type material. Holotype male, Aylmer, Quebec, 13 June, 1960 (G. G. Lewis), reared from *Picea glauca*. Rearing no. 60-107. *Paratypes*: three males, three females, same locality and host as holotype 13-15 June, 1960. One male, Aylmer, Quebec, 2 July, 1935 (G. S. Walley). One male, Hull, Quebec, 26 June, 1946. F.I.S., reared from white spruce. Two males, Kingsmere (near Hull), Quebec, 14, 15 June, 1941. F.I.S., reared from white spruce. One male, Stittsville, Ontario, 25 June, 1948. F.I.S., reared from

Male Genitalia Fig. 29. *Z. improbana*, n. sp., Vermilion Bay, Ont., *Larix laricina*; Fig. 29a. *Z. improbana*, Laniel, Que., *Larix laricina*; Fig. 29b. *Z. improbana*, Hopedale, Labr; Fig. 29c. *Z. improbana*, Priceville, Ont., larch; Fig. 29d. *Z. improbana*, Burgessville, Ont., larch; Fig. 29e. *Z. improbana*, Ottawa, Ont.; Fig. 29f. *Z. improbana*, Aweme, Man.; Fig. 29g. *Z. improbana*, Beaver R., B.C., *Larix laricina*; Fig. 29h. *Z. improbana*, Nelson, B.C.; Fig. 29i. *Z. improbana*, Yorkton, N.J;



Male Genitalia: Fig. 30. *Z. fortunana*, paratype, Ottawa, Ont.; Fig. 30a. *Z. fortunana*, S. Milford, N.S.; Fig. 30b. *Z. fortunana*, Baddeck, N.S.; Fig. 30c. *Z. fortunana*, Bobcaygeon, Ont; Fig. 30d. *Z. fortunana*, Black Sturgeon Lake, nt., *Picea glauca*; Fig. 30e. *Z. fortunana*, Black Sturgeon Lake, Ont., *Picea glauca*; Fig. 30f. *Z. fortunana*, Black Sturgeon Lake, Ont., *Picea glauca*; Fig. 30g. *Z. fortunana*, Black Sturgeon Lake, Ont., *Picea glauca*; Fig. 30h. *Z. fortunana*, Black Sturgeon Lake, Ont., *Picea glauca*; Fig. 30i. *Z. fortunana*, B.C., *Picea glauca*; Fig. 30j. *Z. fortunana*, B.C., *Picea glauca*; Fig. 30k. *Z. fortunana*, Dragon Lake, B.C., *Picea glauca*; Fig. 30l. *Z. fortunana*, Hospital Cr., B.C., *Picea engelmanni*.

white spruce. One male, three females, Hazeldean, Ontario, 2, 4 July, 1947. F.I.S., reared from white spruce. Three males, one female, South March, Ontario, 21-24 June, 1949. F.I.S., reared from white spruce. Four males, three females, Ottawa, Ontario, 27 June - 2 July, 1905 (C. H. Young). Two females, Ottawa, Ontario, 10, 12 July, 1906 (C. H. Young). One male, Ottawa, Ontario, 29 June, 1935 (C. H. Young). One female, Ottawa, Ontario, 28 June, 1931 (C. H. Young). Four females, Ottawa, Ontario, 26-29 June, 1948. F.I.S., reared from white spruce. One female, Ottawa, Ontario, 15 June, 1941. F.I.S., reared from white spruce. One female, Bell's Corners, Ontario, 11 June, 1941 (J. McDunnough), reared from spruce. All type specimens No. 9485 in the Canadian National Collection, Ottawa, Ontario.

Distribution. Transcontinental in Canada and the northern United States.

Host plants. *Picea glauca* (Moench) Voss and *P. sitchensis* (Bong.) Carr.

Remarks. This is the North American species that various authors have considered to be the European *Z. ratzeburgiana*. Our studies have shown that there are distinctive differences between them, mainly as follows:

Z. canadensis. Outer margin of basal patch distinctly concave or indented on costal half. Subapical white streak prominent, without white dashes through base of fringe. Female with one large and one small signum in bursa.

Z. ratzeburgiana. Outer margin of basal patch linear on costal half. Subapical white streak faint with prominent white dashes through base of fringe. Female with two equal sized signa in bursa.

4. *Zeiraphera improbana* (Walker)

Sciaphila improbana Wlk., 1863, *Cat. Lep. Het.* 28: 337.

Zeiraphera improbana (Wlk.), McDunnough, 1959, *Amer. Mus. Novit.* No. 1954: 2.

Sciaphila indivisana Wlk., 1863, *Cat. Lep. Het.* 28: 344. (New synonymy).

Paedisca diffinana Wlk., 1863, *Cat. Lep. Het.* 28: 378.

Zeiraphera diffinana (Wlk.), McDunnough, 1959, *Amer. Mus. Novit.* No. 1954: 2.

Cydia pseudotsugana Kft., 1904, *Can. Ent.* 36: 110. (New synonymy).

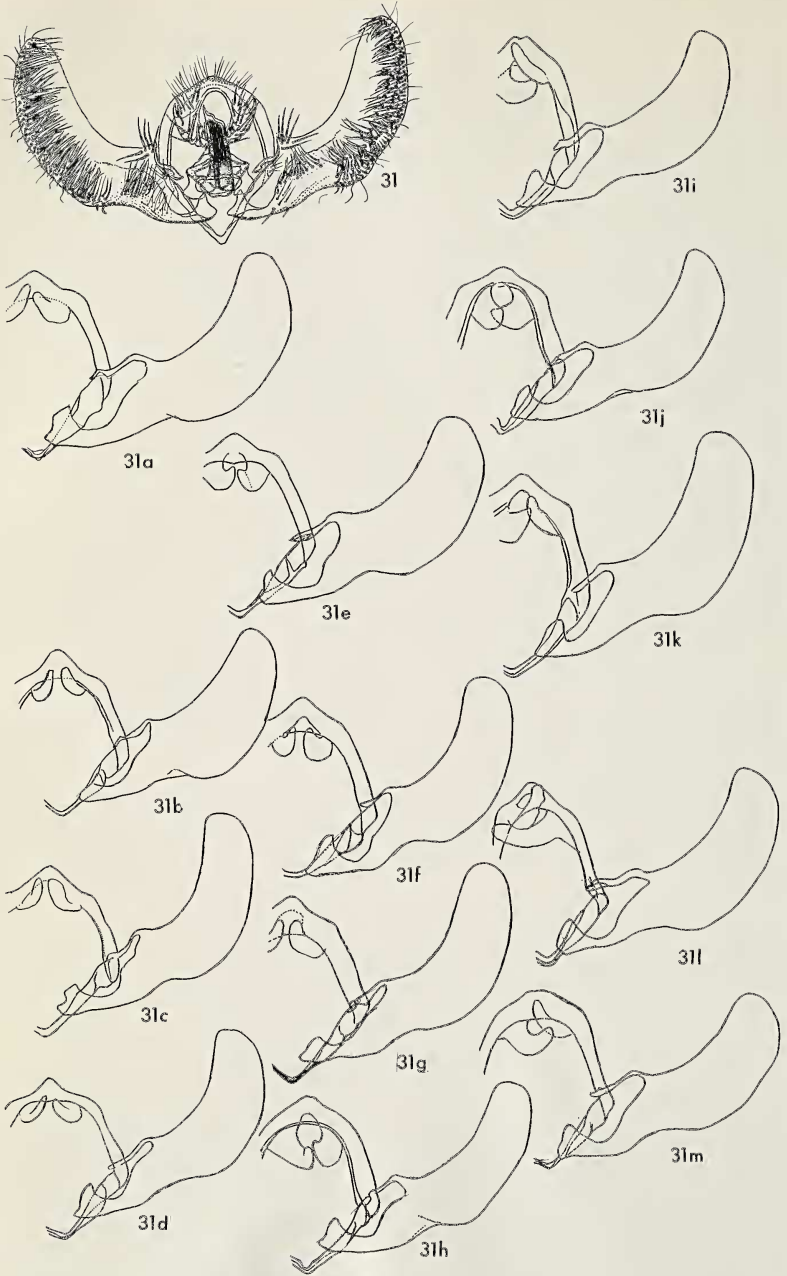
Thiodia pseudotsugana (Kft.), Dyar, 1904, *Proc. U. S. Nat. Mus.* 27: 927.

Epinotia pseudotsugana (Kft.), 1905, *Can. Ent.* 37: 89, 253.

Enarmonia pseudotsugana (Kft.), Barnes and McDunnough, 1917, *Check List Lep. Bor. Amer.* No. 7143.

Zeiraphera psuedotsugana (Kft.), Heinrich, 1923, *U. S. Nat. Mus. Bull.* 123: 171.

Zeiraphera pseudotsugana (Kft.), Klots, 1942, *Bull. Amer. Mus. Nat. Hist.* 79: 408.



Zeiraphera diniana: Heinrich, 1923, *U. S. Nat. Mus. Bull.* 123: 171, Fig. 287; Forbes, 1923, *Cornell Univ. Agt. Exp. Sta. Mem.* 68: 446; Prentice, et al., 1965, *Dept. Forestry Can., Publ.* 1142, 4: 629.

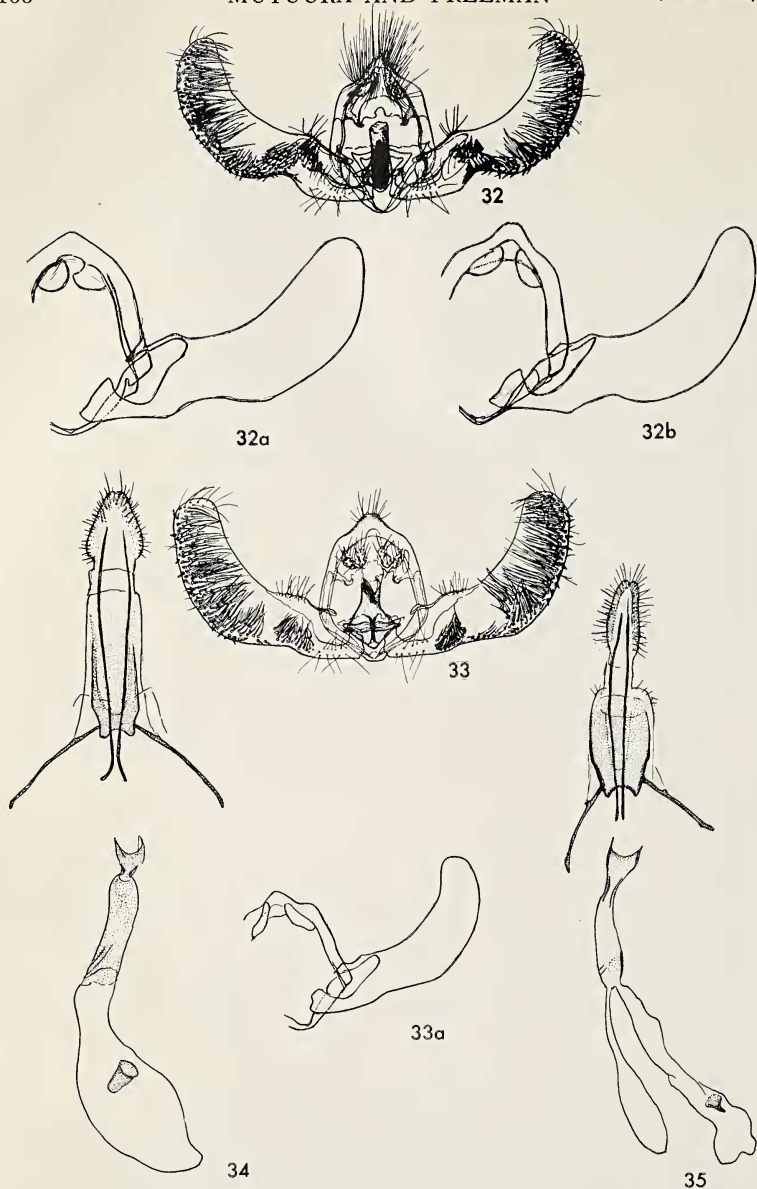
Zeiraphera sp. probably *diniana*: MacKay, 1959, *Can. Ent. Suppl.* 10: 97.

External characters. Frons roughly scaled, the scales greyish black, with pale fawn apices. Vertex rough, greyish black. Palpus fuscous inwardly, blackish outwardly. Antenna with alternate black and grey bands. Thorax blackish brown, the scales with pale fawn apices. Abdomen dark fuscous; terminal segment brownish. Tibiae and tarsi of fore- and mid-legs blackish fuscous, with pale fawn bands. Hind tibia and tarsus pale fuscous, with pale fawn bands. Forewing (Figs. 7-11) with basal patch, median band, and post median band variously obscured with a black or blackish grey ground color; basal patch extending obliquely outward from just beyond inner fourth of costa to middle of wing, then acutely angled inward to dorsum; median band greyish, divided into a small costal patch and a large dorsal patch, the costal patch semi-circular and containing two costal dashes, the brownish dorsal patch quadrate and edged with whitish-grey scales; post median band blackish with some brown scales; apical third blackish grey and with three costal geminations; submarginal line broken, black, with some golden brown scales; tornal spot greyish, obscure, and containing an irregular line of black and golden brown scales; fringe dark grey, whitish near tornus, and with broken black basal line. Hind wing dark grey; fringe fuscous, with dark grey basal line. Wingspread 10-18 mm..

Male genitalia (Figs. 29-29i). Uncus broadly conical; apex rounded, sometimes shallowly notched. Socii well developed, long, widest near middle. Aedeagus short, stout; apex truncate; cornuti a cluster of 30-60 elongate spines.

Female genitalia (Figs. 40-40c). Anterior and posterior apophyses longer than in other species with one signum. Ostial plate

Male Genitalia Fig. 31. *Z. destitutana*, Black Sturgeon Lake, Ont., *Picea glauca*; Fig. 31a. *Z. destitutana*, Parrsboro, N.S.; Fig. 31b. *Z. destitutana*, Baddeck, N.S.; Fig. 31c. *Z. destitutana*, Edmundston, N.B., *Abies balsamea*; Fig. 31d. *Z. destitutana*, Mt. Lyall, Que; Fig. 31e. *Z. destitutana*, Upsala, Ont., *Picea glauca*; Fig. 31f. *Z. destitutana*, Finland, Ont., *Picea glauca*; Fig. 31g. *Z. destitutana*, Black Sturgeon Lake, Ont. *Picea glauca*; Fig. 31h. *Z. destitutana*, S. E. Corner, Yukon T., *Picea glauca*; Fig. 31i. *Z. destitutana*, Kamloops, B.C., *Picea engelmanni*; Fig. 31j. *Z. destitutana*, Big Bend Hwy., B.C., *Picea engelmanni*; Fig. 31k. *Z. destitutana*, Big Bend Hwy., B.C., *Picea engelmanni*; Fig. 31l. *Z. destitutana*, Scully Ck., B.C., *Picea sitchensis*; Fig. 31m. *Z. destitutana*, Nation River, B.C., *Abies laciocarpa*.



Male Genitalia Fig. 32. *Z. hesperiana* n. sp., Pavilion, B.C., *Pseudotsuga menziesii*; Fig. 32a. *Z. hesperiana* n. sp., Canal Flats, B.C., *Pseudotsuga menziesii*; Fig. 33. *Z. vancouverana*, paratype, Ucluelet, Vancouver Is., B.C.; Fig. 33a. *Z. vancouverana*, paratype, Ucluelet, Vancouver Is., B.C. Fig. 34-42. Female genitalia; Fig. 34. *Z. hesperiana* n. sp. Powell River, B.C., *Pseudotsuga menziesii*; Fig. 35. *Z. vancouverana*, Vancouver Is., B.C.

narrow, emarginate. Ostium small, cup shaped. Ductus bursae slightly sclerotized, without sclerotized ring at neck of bursa. One signum present, variable in size and shape.

Flight period. Late June to early August.

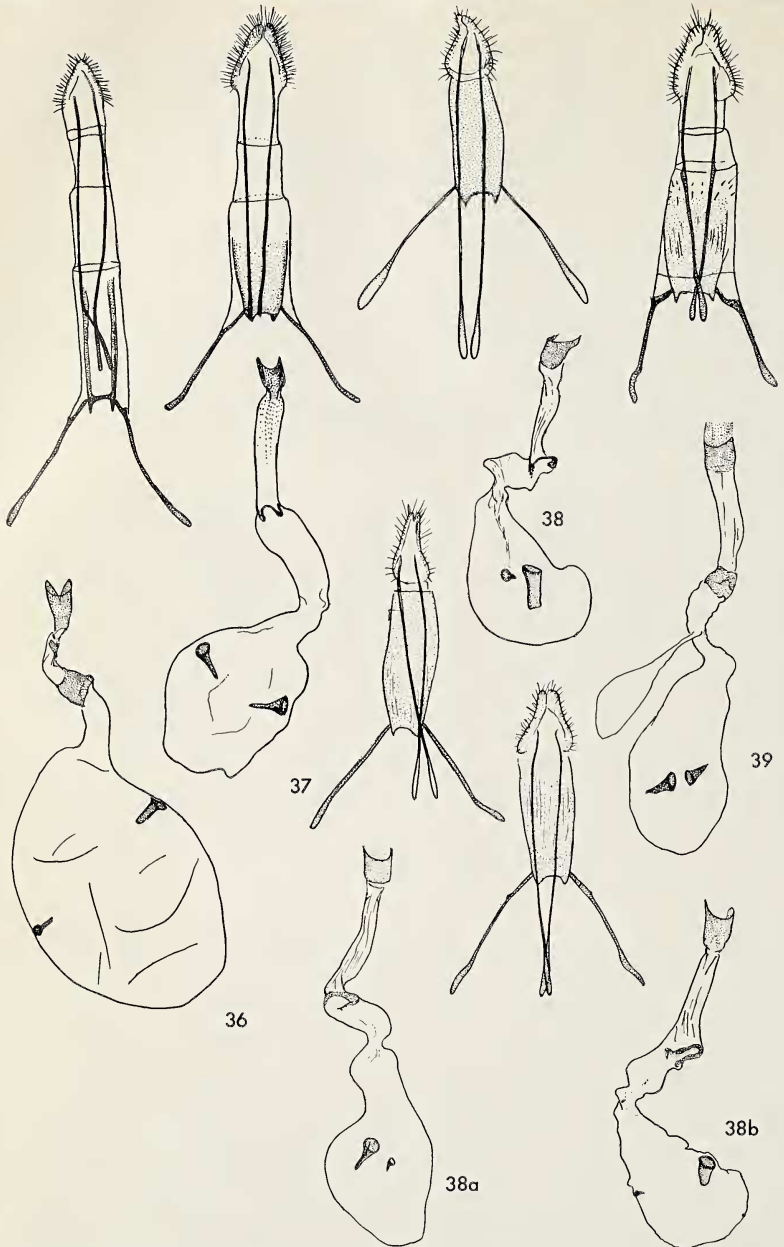
Type locality. St. Martin's Falls, Albany River, Northern Ontario.

Distribution. Transcontinental in southern Canada and the northern United States.

Host plants. *Larix laricina* (Du Roi) K. Koch and *L. occidentalis* Nutt.

Remarks. This is the species that North American authors have usually associated with the name *Z. diniana* Gn. as previously noted in the introduction to this paper. The names *improbana* Wlk., and *diffiniana* Wlk. have been associated with various species during their taxonomic history. McDunnough (1959) with the help of lepidopterists at the British Museum (Natural History), London, England, established that the two Walker names were synonymous and applied to a *Zeiraphera* species. Subsequently Obraztsov (in litt.) studied Walker's type of *indivisana* and realized that it also was synonymous with *improbana*. All three were described from St. Martin's Falls, are variants of a single species, and are indistinguishable from the North American larch feeding species.

Kearfott (1904) described *pseudotsugana* from flown specimens taken by Dyar at Kaslo, Kokanee Mt., and iKtchener Glacier, British Columbia. Dyar also reared specimens from *Pseudotsuga* which he thought were the same species. The paratype at the American Museum of Natural History, New York City, N.Y., is a headless female from Kaslo (Fig. 7) and is undoubtedly the dark colored *Larix* feeder. The only other type material in existence is a paratype in the Canadian National Collection, Ottawa, Ont., from Kitchener Glacier. It also is the *Larix* feeder. Both of these paratypes agree with the original description and it is apparent that Kearfott did not have specimens reared from *Pseudotsuga*. It follows therefore, that the oldest name *improbana* applies to this species. It may be recognized by the dark, indistinct maculation and its host preference of *Larix*.



Female genitalia: Fig. 36. *Z. claypoleana*, Cincinnati, Ohio; Fig. 37. *Z. pacifica*, paratype, Sandspit, B.C., *Picea sitchensis* Fig. 38. *Z. canadensis*, n. sp., Bell's Corner, Ont., spruce; Fig. 38a. *Z. canadensis*, n. sp., Radium Hot Springs, B.C., *Picea* sp; Fig. 38b. *Z. canadensis*, n. sp., Hazelton, B.C., *Picea sitchensis*; Fig. 39. *Z. ratzburgiana*, Germany, *Picea excelsa*.

5. *Zeiraphera fortunana* (Kearfott)

Epinotia fortunana Kearfott, 1907, *Can. Ent.* 39:126.

Enarmonia fortunana (Kft.), 1917, Barnes and McDunnough, *Check List Lep. Bor. Amer.*, No. 7168.

Zeiraphera fortunana (Kft.), Heinrich, 1923, *U. S. Nat. Mus. Bull.* 123: 172, fig. 288; Forbes, 1923, *Cornell Univ. Agric. Exp. Sta. Memoir* 68:446; Klots, 1942, *Bull. Amer. Mus. Nat. Hist.* 79: 402; MacKay, 1959, *Can. Ent. Suppl.* 10: 96, fig. 85; Prentice, et. al., 1965, *Dept. Forestry Can.*, Publ. 1142, 4: 630.

External characters. Frons smoothly scaled, whitish grey. Vertex with long, whitish-grey scales. Palpus cream white, blackish outwardly. Antenna pale fawn. Thorax dark brown, edged with pale fawn. Abdomen dark fuscous. Tibiae and tarsi of fore- and mid-legs blackish fuscous, with whitish-grey bands. Hind tibia and tarsus pale fuscous, with whitish-grey bands. Forewing (Figs. 12-14) with basal patch cream-white, mottled with blackish, and extending from beyond inner fourth of costa obliquely outward to middle of wing, then obtusely angled inward to dorsum, which it reaches just beyond inner third; median band creamy-white, angulated at middle of wing, and containing a shining, pale ochreous line and a blackish costal dash; post-median band blackish brown, irregular in outline, broader at trailing edge; apical third of wing irregularly mottled with whitish-brown and blackish-brown areas, with three costal dashes, and a broken submarginal line; fringe fuscous, with broken darker basal line. Hind wing fuscous; fringe pale fuscous, with fuscous basal line. Wingspread 12-15 mm.

Male genitalia (Figs. 30-30l). Uncus reduced, with apex truncate or slightly notched. Socii well developed, broadly sickle shaped. Tegumen not produced at the shoulder. Clasper short; apex narrow. Aedeagus short, stout; apex truncate; cornuti a cluster of 16-24 elongate spines.

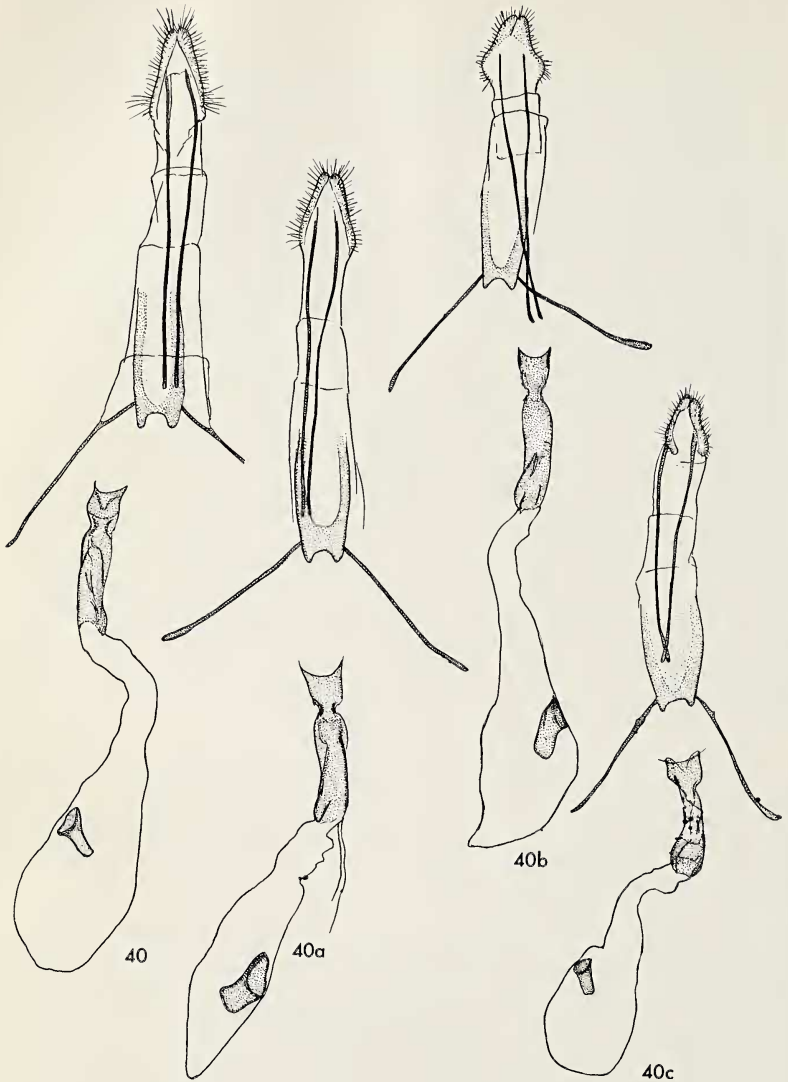
Female genitalia (Figs. 41-41c). Anterior and posterior apophyses moderate in size. Ostial plate broad, emarginate. Ostium somewhat cup shaped. Ductus bursae weakly sclerotized. One signum present, somewhat conical, rather large.

Flight period. Early June to late July.

Type locality. Ottawa, Ontario.

Distribution. Nova Scotia to British Columbia.

Host plants. *Picea glauca* (Moench) Voss, *P. engelmanni* Parry.



Female genitalia: Fig. 40. *Z. improbana*, Hopedale, Labr., Que.; Fig. 40a. *Z. improbana*, Ottawa, Ontario; Fig. 40b. *Z. improbana*, Anarchist Mtn., B.C., *Larix occidentalis*; Fig. 40c. *Z. improbana*, Anarchist Mtn., B.C., *Larix occidentalis*.

Remarks. This species apparently is well distributed throughout the spruce regions of Canada. It is closely allied to *Z. destitutana* but *fortunana* is smaller in wingspread and in size of genitalia. The frons and vertex of *fortunana* are whitish ochreous; those of *destitutana* are greyish brown. The uncus of *fortunana* is somewhat notched; that of *destitutana* is rounded at the apex. The ostial plate of *fortunana* is broader and shorter than that of *destitutana*.

6. *Zeiraphera destitutana* (Walker)

Sciaphila destitutana Wlk., 1863, *Cat. Lep. Het.* 28: 339.

Zeiraphera destitutana (Wlk.), McDunnough, 1959, *Amer. Mus. Novit.* No. 1954: 3.

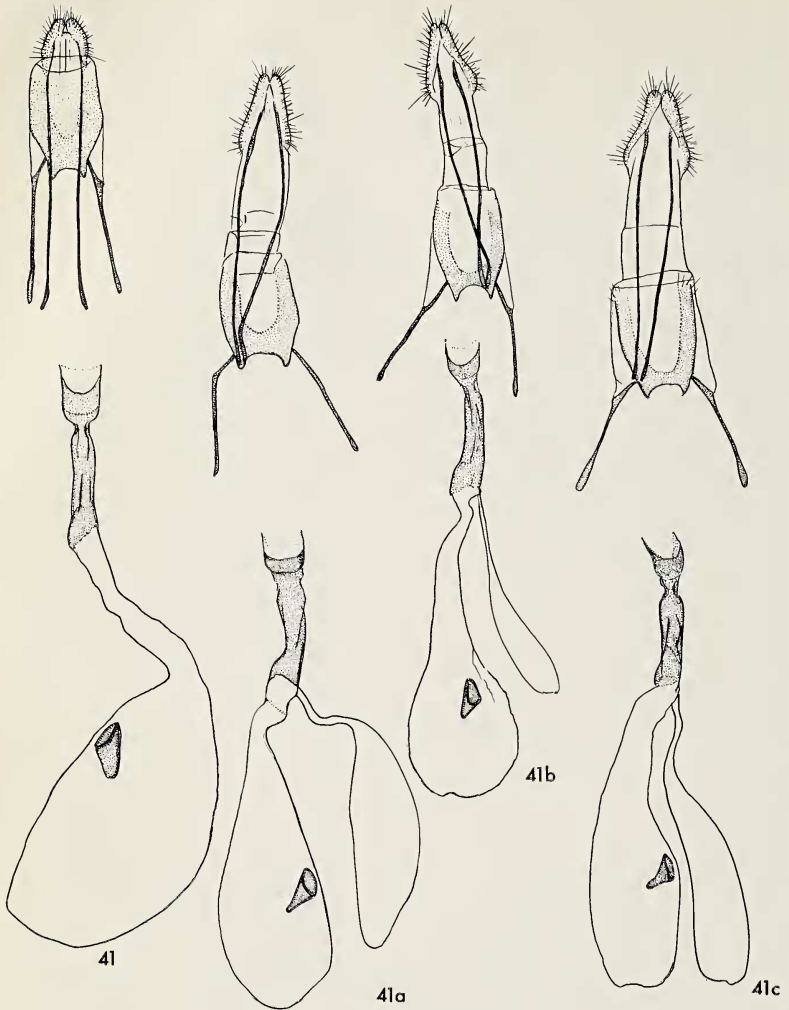
External characters. Frons smooth, white below, with overlapping, long, greyish-brown scales laterally and dorsally. Vertex greyish brown. Palpus whitish grey inwardly, dark fuscous outwardly and apically. Antenna fuscous, with darker fuscous scales; scape blackish fuscous inwardly, much paler outwardly. Thorax brownish fuscous. Abdomen pale fuscous. Tibiae and tarsi of fore- and mid-legs blackish fuscous, with greyish bands. Hind leg whitish. Forewing (Figs. 15-18) with basal patch whitish grey, mottled with blackish, margined outwardly with black, costal margin with three black costal dashes; basal patch extending from beyond basal fourth of costa obliquely outward to middle of wing, then almost at right angles inwardly to dorsum, which it reaches just beyond basal half; median band whitish, constricted at middle of wing to form a costal spot and a dorsal patch; an irregular blackish post median band extending across the wing; apical third irregularly mottled with black, white, whitish-grey, and brownish scales; costa with three blackish geminations on apical third; subapical spot black, confluent with the two outer costal geminations; tornal region whitish; subapical line broken into black spots; fringe with blackish and brownish scales, whitish near tornus and with a black and white basal line. Hind wing blackish fuscous; fringe blackish fuscous, with black basal line. The female is more distinctly marked with white than the male. Wingspread 14-17 mm.

Male genitalia (Figs. 31-31m). Uncus poorly developed. Tegumen not strongly shouldered. Clasper broad, broadly rounded apically. Cornuti a cluster of about 24-40 elongate spines.

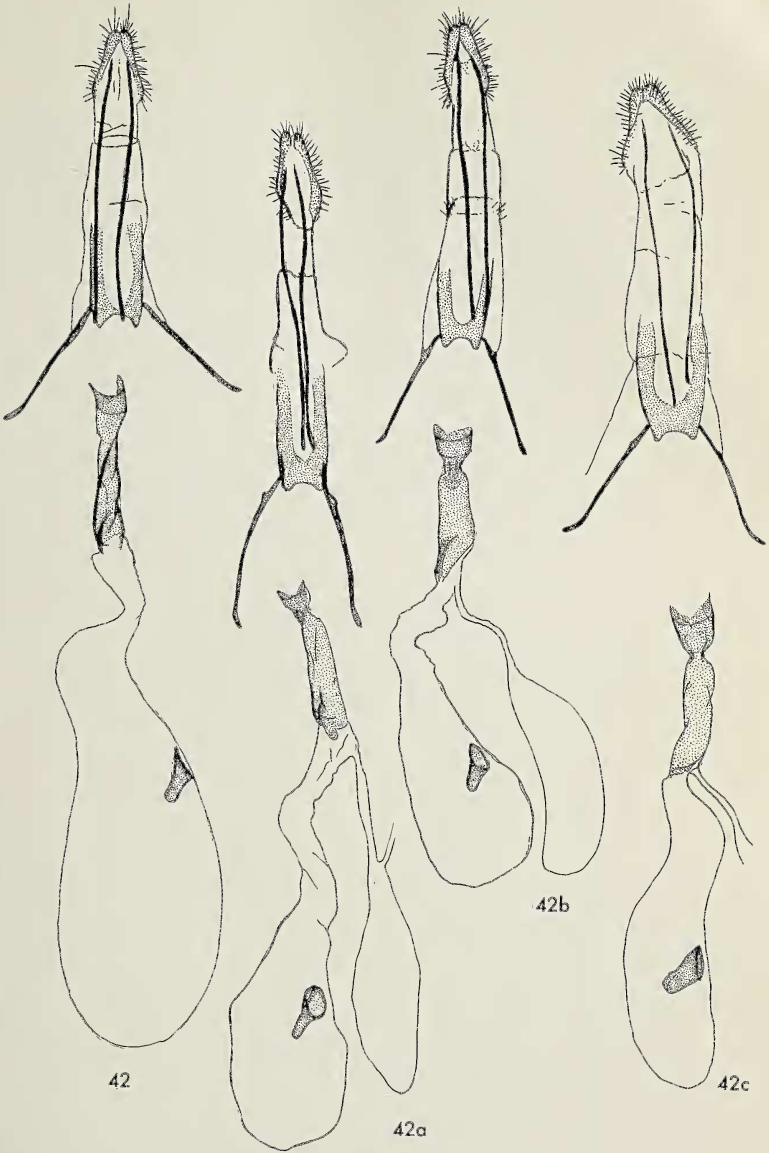
Female genitalia (Figs. 42-42c). Similar to those of *Z. improbana* Wlk.

Flight period. July and early August.

Type locality. St. Martin's Falls, Albany River, Ontario.



Female genitalia: Fig. 41. *Z. fortunana*, paratype, Ottawa, Ont.; Fig. 41a. *Z. fortunana*, Black Sturgeon Lake Ont., *Picea glauca*; Fig. 41b. *Z. fortunana*, Black Sturgeon Lake, Ont., *Picea glauca*; Fig. 41c. *Z. fortunana*, Yukon Territory, *Picea glauca*; Fig. 42. *Z. destitutana*, Kazubazua, Que; Fig. 42a. *Z. destitutana*, Black Sturgeon Lake, Ont., *Picea glauca*; Fig. 42b. *Z. destitutana*, Nelson, B. C., *Picea glauca*; Fig. 42c. *Z. destitutana*, Hudson-Hope, B.C., *Picea glauca*.



Distribution. Nova Scotia to British Columbia.

Host plants. *Picea glauca* (Moench) Voss, *P. mariana* (Mill.) B.S.P., *P. engelmanni* Parry, *P. sitchensis* (Bong.) Carr., *Abies balsamea* (L.) Mill., *A. lasiocarpa* (Hook.) Nutt. and *A. amabilis* (Dougl.) Forb.

Remarks. This species has been confused with *Z. fortunana* (Kft.). However, it is larger, and the forewing has a mottled appearance and a larger dorsal patch. It also has considerable variation from light contrasting markings to dark suffused ones. The apex of the male uncus is entire, not notched as in *fortunana*, and the female ostial plate of *distitutana* is longer and narrower, resembling that of *improbana*.

7. *Zeiraphera hesperiana* n. sp.

External characters. Frons roughly scaled, dark fuscous. Vertex greyish brown, roughly scaled, with a large tuft of the scales between antenna and upper side of compound eye. Palpus whitish ochreous inwardly, darker apically and outwardly. Antenna fawn with whitish scales; inner side of scape blackish, outer side whitish. Thorax dark brown, sprinkled with pale scales. Abdomen pale fuscous. Tibiae and tarsi of fore- and mid-legs blackish fuscous, with greyish bands. Hind tibia pale fuscous; tarsus somewhat blackish fuscous with a greyish band at apex. Forewing (Figs. 19-22) with basal patch grey, mottled with black spots, and extending from just beyond inner fourth of costa obliquely outward to middle of wing, then acutely angled inwardly to just beyond inner third of dorsum; median band divided into a whitish grey costal area and a large, whitish, semi-circular patch on dorsum, the costal area usually with three blackish costal dashes, the dorsal patch extending from dorsum to middle of wing, with four obscure black dashes on dorsal edge, and with mottled black and light brown scales in the middle; post-median band irregular, blackish, extending across the wing, narrower at costa; apical third with four blackish costal geminations, and a black subapical spot; tornal spot golden brown or whitish, mottled with black; submarginal line broken, black and brown; fringe dark grey, with some white-tipped scales, and a broken, darker, basal line. Hind wing dark fuscous; fringe light grey, with a darker basal line. Wingspread 15.0-20.5 mm.

Male genitalia (Figs. 32-32b). Uncus reduced; apex rounded. Socii well developed, broadly sickle shaped. Tegumen rounded at shoulder. Clasper large, long; apical region broad. Aedeagus short, stout; apex truncate; cornuti a cluster of about 23-34 elongate spines.

Female genitalia (Figs. 34). Ostial plate narrow, emarginate. Ostium small, cup-shaped. Ductus bursae slightly sclerotized, with a broad, sclerotized ring at neck of bursa. One sub-conical, rather large signum present.

Type material. Holotype male, Courtenay, B.C., 9 July, 1951, F.I.S., reared from Douglas fir. *Paratypes:* Two males, two females, Cowichan Lake, 27 July, 1944 (M. L. Prebble). Two males, Bridesville (Osoyoos district), 17 July, 1952. One male, Kaleden (Similkameen district), 8 July, 1952. One male, one female, Eneas Creek (Okanagan district) 6, 5 July, 1954. One male, Kitchener, 20 July, 1950. One male, Shuswap Falls (Kamloops district), 24 July, 1951. One male, Tappen Valley (Kamloops district), 17 July, 1954. One male, Tlupana Inlet (Vancouver Island) 28 July, 1954. One female, Powell River (New Westminster district), 24 July, 1950. One male Canal Flats, 25 July, 1950. One female, Dutch Creek (Kootenay district), 26 July, 1949. One female, Fairmont Hot Springs (Kootenay district), 27 July, 1949. All the above paratypes are from British Columbia and reared from Douglas fir by the Canada Forest Insect Survey. All type specimens No. 9486 in the Canadian National Collection, Ottawa, Ontario.

Distribution. Southern British Columbia.

Host plant. *Pseudotsuga menziesii* (Mirble) Franco.

Remarks. On the basis of similarities in the genitalia, this species is closely allied to *Z. destitutana*.

8. *Zeiraphera vancouverana* McDunnough

Zeiraphera vancouverana McDunnough, 1925, *Can. Ent.* 57: 21.

External characters. Frons and vertex roughly scaled, dark brown. Antenna blackish brown; scape blackish brown inwardly, pale brown outwardly. Palpus pale fuscous inwardly, dark brown outwardly. Thorax and tegula dark brown. Abdomen blackish brown; terminal segment paler. Fore- and mid-legs blackish brown, with pale whitish-brown bands. Hind leg pale whitish fuscous; tarsus somewhat fuscous, with pale whitish bands. Forewing (Figs. 23, 24) with basal patch fuscous, mottled with brown, margined outwardly with blackish on dorsal half, and extending from beyond inner fourth of costa obliquely outward to middle of wing, then acutely angled inwardly to dorsum just beyond inner third; median band divided into a pale brown costal portion and a whitish grey, sub-rectangular, oblique dorsal

patch; apical third mottled with whitish grey, brown, and dark fuscous areas; fringe dark brown, with a broken blackish-fuscous basal line. Hind wing dark brown; fringe paler, with a pale blackish-fuscous basal line. Wingspread 11-14 mm.

Male genitalia (Figs. 33, 33a). Resembling those of *fortunana*. Uncus round at apex, not notched. Socii well developed, broadly sickle shaped. Tegumen angled at the shoulder. Apical region of clasper only slightly narrowed. Aedeagus short, stout; apex truncate; cornuti a cluster of 3-6 elongate spines.

Female genitalia (Fig. 35). Anterior and posterior apophyses short. Ostial plate short and broad, narrower basally. Ostium cup-shaped. Ductus bursae slender, not sclerotized. One small signum present.

Flight period. July.

Type locality. Ucluelet, Vancouver Island, British Columbia.

Distribution. Known only from Vancouver Island, British Columbia.

Host plants. *Picea sitchensis* (Bong.) Carr. and *P. engelmanni* Parry.

Remarks. On the basis of the male genitalia, this species is closely allied to *Z. fortunana* (Kft.). It is the smallest species in the genus.